P [actual = "blue"] = 0.2
P [actual $=$ "ye110w"] $=0.8$
P[report = "b7ue" | actual = "b7ue"] = 0.8
$P[$ report $=$ "yellow" | actual = "blue"] = 0.2
P[report = "ye110w" | actual = "ye11ow"] = 0.8
P[report = "blue" | actual = "ye110w"] = 0.2
P[actua] = "ye11ow" | report = "ye11ow"] = P[actua]=
"yellow"] * P[report = "yellow" | actua1 = "yellow"]
"ye110w"]
$\mathrm{P}[$ report $=$ "ye1low"] $=\mathrm{P}[$ actual $=$ "ye1low" $] * P[$ report $=$ "ye1low" | actua1 = "yellow"] + P[actual = "blue"]*P[report = "ye11ow" | actual = "blue"]

$$
=0.2 * 0.8+0.8 * 0.2=0.32
$$

$\mathrm{P}[$ actual $=$ "yellow" | report $=$ "yellow"] $=0.2 * 0.8 / 0.32=$ 0.5
$P$ [emails are spam] $=0.4$
P [emails are not spam] $=0.6$
P[word = "checkout" | emai1 is spam] = 0.01
P[word = "checkout" | email is NOT spam] $=0.004$
P [emai1 is spam | word = "checkout"] = P[emai1 is spam] * P[word = "checkout" | email is spam] / P[word = "checkout"] $\mathrm{P}[$ word $=$ "checkout"] = $\mathrm{P}[$ emai1 is spam]*P[word = "checkout" | email is spam] +

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P[emai] is not spam]*P[word $=$
"checkout" | email is NOT spam]

$$
=0.4 * 0.01+0.6 * 0.004=0.0064
$$

P [emai1 is spam | word $=$ "checkout"] $=0.4 * 0.01 / 0.0064=$ 0.625
$P[$ majority-b7ue $]=1 / 2$
$P[$ majority-red] $=1 / 2$
P[ball picked is "blue" | urn is "majority-blue"] = 2/3
P[bal1 picked is "red" | urn is "majority-blue"] = 1/3
P[bal1 picked is "red" | urn is "majority-red"] = 2/3
P[bal1 picked is "blue" | urn is "majority-red"] = $1 / 3$
P[urn is majority-b7ue | ball picked is blue]
$=P$ [urn is majority-blue] * P[ball picked is blue | urn is majority blue] / P[bal1 picked is blue]

P[ball picked is blue] = P[urn is majority-blue]* P[ba11 picked is "blue" | urn is "majority-blue"] + P[urn is majority-red] * P[ba11 picked is "blue" | urn is "majority-red"]

$$
=1 / 2 * 2 / 3+1 / 2 * 1 / 3=1 / 2
$$

$\mathrm{P}[$ urn is majority-blue | ball picked is blue] $=1 / 2 * 2 / 3 /$ $0.5=2 / 3$

P[urn is majority-blue | balls picked are blue,blue, red] $=P[u r n$ is majority-b7ue] * P[ba11s picked are blue, blue,red | urn is majority-blue] / P[ba11s picked are blue, blue, red]

P[balls picked are blue, blue,red | urn is majority-blue] majority-blue] * $=P[b a 11$ picked is blue $\mid$ urn is P[ball picked is blue | urn is Page 2

CSC434-Fa112014-information-cascade majority-b7ue] *
majority-blue]
$P[b a 11$ picked is red | urn is
$=2 / 3 * 2 / 3 * 1 / 3=4 / 27$
$\mathrm{P}[\mathrm{ba} 11 \mathrm{~s}$ picked are blue, blue, red | urn is majority-red] = $1 / 3 * 1 / 3 * 2 / 3=2 / 27$
$\mathrm{P}[\mathrm{bal1s}$ picked are blue, b7ue, red] $=1 / 2 * 4 / 27+1 / 2 * 2 / 27=$ $1 / 2 * 6 / 27=1 / 9$
$2 / 27 / 1 / 9=2 / 3$

P[see "blue" | hypothesis is "majority-blue"] - high signal (q) > 1/2

P[see "red" | hypothesis is "majority-blue"] - low signa1 (1-q)

P[see "red" | hypothesis is "majority-red"] - low signal (q) $>1 / 2$ "blue" | hypothesis is "majority-red"] - high signal P[see "blue" | hypothesis is "majority-red"] - high signa1 (1-q)
$\mathrm{S}=$ sequence of 'a' high signals and sequence of 'b' low signals
$P$ [majority-blue | S] = P[majority-blue] * P[S | majority-blue] / P[S]
$P[S]=P$ [majority-b7ue] * P[S |
majority-b7ue] + P[majority-red]*P[S | majority-red]

$$
=p * q \wedge a *(1-q) \wedge b+(1-p) *(1-q) \wedge a * q \wedge b
$$

$P[$ majority-b7ue | S$]=\quad \mathrm{p} * \mathrm{q} \wedge \mathrm{a} *(1-q) \wedge b$ $q \wedge b$
$\mathrm{a}>\mathrm{b}$
Since q > 1/2

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$q \wedge a *(1-q) \wedge b \stackrel{C S C}{>}(1-q) \wedge a q \wedge b$
$p * q \wedge a *(1-q) \wedge b+(1-p) *(1-q) \wedge a * q \wedge b<p * q \wedge a *(1-q) \wedge b+\quad . ~$
$(1-p) * q \wedge a *(1-q) \wedge b$ $1 /()>1 /()$

P[majority-blue | s ] > p
$a<b$
$P[$ majority-b7ue | s$]=\quad \mathrm{p} * \mathrm{q} \wedge \mathrm{a} *(1-q) \wedge b$
$p * q \wedge a *(1-q) \wedge b+(1-p) *(1-q) \wedge a *$
$q \wedge b$
$q \wedge b *(1-q) \wedge a>q \wedge a *(1-q) \wedge b$
b > a
$p * q \wedge a *(1-q) \wedge b+(1-p) *(1-q) \wedge a * q \wedge b>p * q \wedge a *(1-q) \wedge b+$ $(1-p) * q \wedge a *(1-q) \wedge b$
$1 /()<1 /()$
$<\mathrm{p}$

